

## DRAWINGS ATTACHED

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- (21) Application No. 3971/70 (22) Filed 27 Jan. 1970  
 (23) Complete Specification filed 29 Dec. 1970  
 (44) Complete Specification published 25 July 1973  
 (51) International Classification B60R 21/08  
 (52) Index at acceptance  
       B7B 236  
       F1E 10A1 17 1B  
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## (54) VEHICLE SAFETY DEVICE

(71) We, THE WALTER KIDDE COMPANY LIMITED, a British Company, of Belvue Road, Northolt, Greenford, Middlesex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a vehicle safety device.

The occupants of a vehicle may be severely injured by impact with an unyielding part of the inside of the vehicle after it has undergone sudden deceleration such as occurs in road accidents. Safety belts have been devised to protect occupants on such occasions but these often restrict movement and furthermore injury can result from the pressure of the body against the unyielding belt.

It is an object of the invention to provide a device which acts as a decelerating buffer to protect vehicle occupants but does not restrict their movement during normal travel.

There are several known safety systems which include an inflatable bag which is normally stowed in a convenient and appropriate position in a vehicle, e.g. behind a removable fascia panel. A sensitive switch element is associated with the inflatable bag so that when actuated it connects the bag to a source of pressured gas. The switch element is normally an inertia switch sensitive to deceleration of the vehicle at more than a predetermined rate. Thus if a vehicle fitted with a safety system of this type is involved in a collision the deceleration involved will energise the switch to connect the pressure source to the inflatable bag. The speed of action of the switch and the pressure of the gas are such that the bag will inflate sufficiently quickly to provide a yielding buffer in front of the vehicle occupant to prevent impact of his body on

a rigid part of the vehicle. It will be understood that several inflatable bags would normally be required in a vehicle so that protection may be provided for each occupant. These known systems suffer the disadvantage that the inflation mechanism, especially the gas storage, is bulky and expensive.

It is therefore a further object of the present invention to provide a simple inflation mechanism for a safety system of this type.

Accordingly a vehicle safety system comprises at least one inflatable bag, a source of pressurised gas connected to said inflatable bag or bags and means responsive to deceleration in excess of a predetermined value for releasing pressurised gas from said source, wherein an air injector is arranged between the or each inflatable bag and the gas source to entrain atmospheric air with the pressurised gas, each inflatable bag being positionable inside a vehicle so that on inflation it may act as a yielding buffer to protect an occupant from impact on an unyielding part of the inside of the vehicle. The use of an air injector entraining atmospheric air flows the size of the gas storage cylinder or other source of pressurised gas to be reduced considerably in size and weight and hence cost.

The air injector is preferably connected to the inflatable bag through a two-way valve permitting very rapid inflation of the bag and relatively slow deflation of the bag to provide an extra cushioning effect. Thus, in an accident, the pressure on the bag due to the occupant's weight will cause the bag to dispel some of its contents through the valve and therefore tend to prevent rebound of the occupant's body and reduce the rate of deceleration. Furthermore the occupant may be more easily freed from the vehicle simply by pressing on the bag to deflate it.

The source of pressurised gas may be a simple pressure vessel having a high rate of discharge valve and containing a pressurised gas or a gas generator containing, for example, liquid carbon dioxide or other vaporising liquid of low boiling point. A single pressure source may be used to supply all the inflatable bags in one vehicle.

The inflatable bag or bags may be positioned anywhere in a vehicle where on inflation they protect an occupant from possible injury. In particular they are advantageously placed in stowage compartments in the fascia panel of the vehicle or in the central boss of the steering wheel. In the latter case the steering column may be made hollow and act as an air injection tube.

Preferably the system includes an inertia switch responsive to a predetermined rate of deceleration.

The invention will now be further described by way of example with reference to the drawings accompanying the provisional specification, in which:—

Figure 1 shows an inflatable bag and air injector mounted in a vehicle fascia panel,

Figure 2 shows a two-way valve incorporated in the air injector of Figure 1,

Figure 3 shows a modified form of air injector,

Figure 4 shows a vehicle steering wheel and column adapted to accommodate an inflatable bag,

Figure 5 shows a typical vehicle safety system in accordance with the invention,

Figure 6 shows a pressurised gas source having a high rate discharge nozzle, and

Figure 7 shows a gas generator for use with the invention.

Referring to Figures 1 and 2, a folded inflatable bag 1 is mounted in a stowage compartment 2 in the fascia 3 of a vehicle. A cover panel 4 on the compartment 2 is designed to blow out on inflation of the bag 1. The wall at the inner end of the compartment 2 is formed into an air injector 5, a pressure supply nozzle 6 being mounted adjacent thereto by means of a spider 7. The injector 5 may incorporate a two-way valve 8 shown in detail in Figure 2. The valve 8 comprises a valve plate 9 pivotally mounted at 10 over the inner end of the injector 5. A spring 11 is associated with the mounting to keep the plate 9 normally closed. An aperture 12 is formed in the centre of the plate 9 and is covered by a rubber flap 13 mounted on the pressure supply side of the plate 9 and operable in the opposite sense to the plate 9. Thus on inflation the gaseous pressure opens the

valve 8 by forcing open the plate 9 against the action of spring 11. When the pressure inside the bag 1 is substantially the same as that provided by the injector 5 the plate 9 will shut and according to the size of the aperture 12 and the stiffness of the flap 13 a controlled deflation of the bag is allowed. As stated earlier the provision of this feature helps to prevent rebound of an occupant and also facilitates release after an accident. It should be understood that it is not strictly necessary for the aperture through which the bag may be deflated to be arranged in the valve plate 9. A similar aperture and flap arrangement could be located in any part of the surface of the injector which is within the bag when it is inflated. Similarly the bag itself may have an aperture positioned in an appropriate part of the bag so that the latter will still inflate rapidly.

A similar arrangement to that of Figure 1 is shown in Figure 3. The difference lies in that the inner end wall of the stowage compartment 2 is formed with a simple aperture which receives an air injector unit 14 having a pressure supply inlet 15 and a two-way valve 8 as before.

An arrangement in which an inflatable bag 21 is mounted in the enlarged central boss 22 of the vehicle steering wheel 23 is shown in Figure 4. The steering column 24 is hollow and conveys gas and air from an air injector 25 at the remote end of the column 24, to which gas is supplied through nozzle 26. The boss 22 is provided with a blow-out cover 22a.

A complete vehicle safety system is shown schematically in Figure 5. A pressure vessel 30 containing gas under pressure is fitted with a high rate discharge valve 32 which is connected via conduits 35 to the air injectors 36 of suitably placed inflatable bags 31. The valve 32 includes a cartridge 34 which is energised to open the valve 32 on actuation of an inertia switch 33 connected to the cartridge by wires 37. There are several known inertia switches sensitive to a predetermined rate of change of velocity which are suitable for use as the switch 33.

The pressure vessel 30 and valve 32 are shown in more detail in Figure 6. The valve 32 is threaded onto the vessel 30 and adjacent this connection is provided with a sealing disc 38. This disc is designed to rupture on impact of a bullet 40 contained in a cartridge unit 34 which is mounted in an aligned threaded aperture of the valve 32. Rupturing the disc 38 allows pressure gas to escape through the outlets 39 and hence flow to the inflatable bags.

An alternative pressure source is shown in Figure 7. A gas generator 41 includes a container 42 holding for example liquid

carbon dioxide and an outlet 43 having a sealing diaphragm 44. A cartridge unit 45 is mounted in the container 42 and includes an electric igniter 46 connected to an inertia switch as before, and a propellant charge contained in a main cylinder 47 of the unit 45. A deflector 48 is mounted between the charge and the outlet 43. The firing of the charge in cylinder 47 increases the pressure in the gas generator to such extent that the sealing diaphragm is ruptured and a mixture of gas and liquid is forced down the conduits to the injector nozzle where the remaining liquid evaporates.

15 The operation of the safety device is the same for all embodiments. Sudden decrease of velocity of the vehicle will cause the inertia switch to fire a cartridge arranged to break a seal on a pressurised gas source and thereby allow pressurised gas to flow to the air injector of an inflatable bag. The injector is so designed that large quantities of air are entrained with the pressurised gas to inflate the bag and thus the size of the pressure source may be substantially reduced as compared with that required for a system not using an air injector. On inflation the bag blows out its removable cover and expands to substantially fill the space in front of a vehicle occupant.

It will be understood that the inflatable bag or bags are inflated to a final pressure only slightly in excess of atmospheric pressure so that they may yield under the impact of the body or head of the vehicle occupant thus providing a buffering or cushioning effect. The use of the described two-way valve provides a dashpot effect to prevent undue increase in pressure in the bag under the impact of an occupant and thus prevent or reduce rebound effects.

#### WHAT WE CLAIM IS:—

1. A vehicle safety system comprising at least one inflatable bag, a source of pressurised gas connected to said inflatable bag or bags and means responsive to deceleration in excess of a predetermined value for releasing pressurised gas from said source, wherein an air injector is arranged between the or each inflatable bag and the gas source to entrain atmospheric air with the pressurised gas, each inflatable bag being positionable inside a vehicle so that on inflation it may act as a yielding buffer to protect an occupant from impact on an unyielding part of the inside of the vehicle.
2. A vehicle safety system as claimed in claim 1 wherein the air injector is connected to the inflatable bag through a two-way valve permitting rapid inflation of the bag and relatively slow deflation thereafter.

3. A vehicle safety system as claimed in claim 2 wherein the two-way valve is constituted by a valve-plate pivotally mounted on said air injector and resiliently loaded to block the passage therethrough, said valve plate having an aperture covered by a rubber flap on the inlet side of said plate, the arrangement being such that inlet gas pressure presses the rubber flap against said aperture and opens said valve-plate to allow inflation of the bag and thereafter the bag may deflate by gas passing through said aperture at a rate controlled by the stiffness of said rubber flap.

4. A vehicle safety system as claimed in any preceding claim wherein said gas releasing means includes an inertia switch responsive to a predetermined rate of deceleration.

5. A vehicle safety system as claimed in claim 4 wherein in operation the inertia switch actuates an explosive cartridge arranged to fire a bullet to rupture a sealing disc of said source of pressurised gas to release said gas.

6. A vehicle safety system as claimed in claim 4 wherein in operation the inertia switch actuates an electric igniter which fires a propellant charge contained in a cartridge in said source of gaseous pressure, said source having a seal adapted to rupture on substantially increased internal pressure and release said gas.

7. A vehicle safety system as herein described with reference to and as illustrated in the drawings accompanying the provisional specification.

8. A vehicle having a safety system as claimed in any preceding claim wherein at least one inflatable bag is located in a stowage compartment in the fascia panel of said vehicle, said compartment having a blow-out cover.

9. A vehicle having a safety system as claimed in any one of claims 1 to 7 wherein at least one inflatable bag is located in the central boss of the vehicle steering wheel, said boss having a blow-out cover.

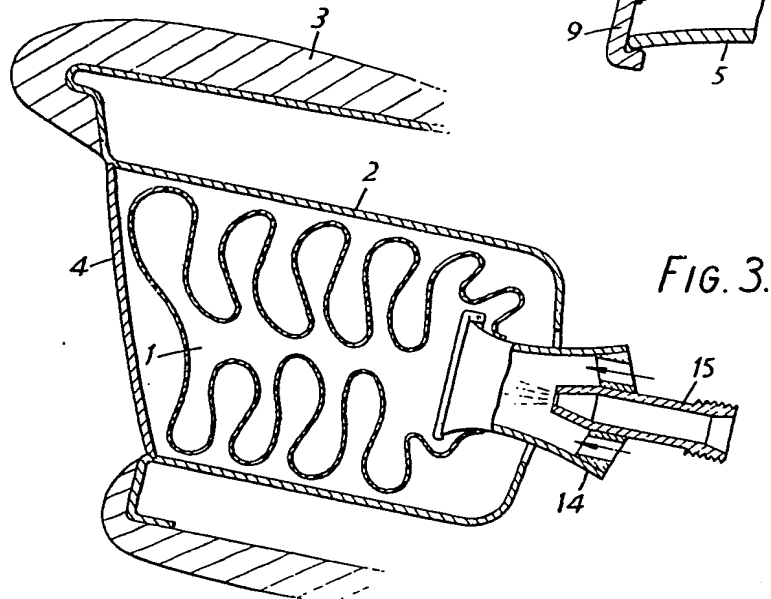
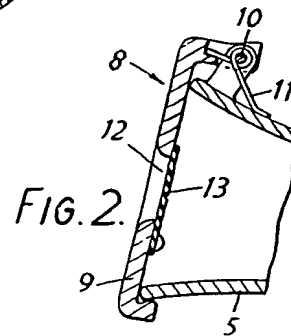
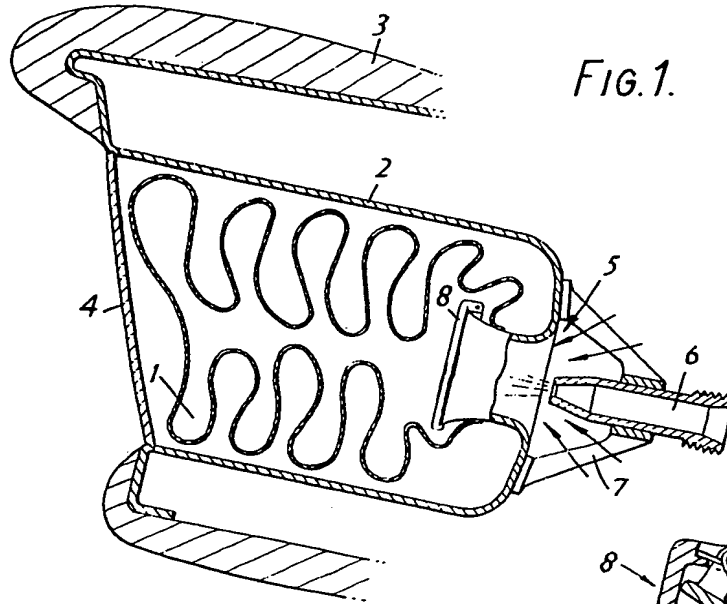
10. A vehicle having a safety system as claimed in claim 9 wherein the steering column is hollow and connects the air injector to said inflatable bag.

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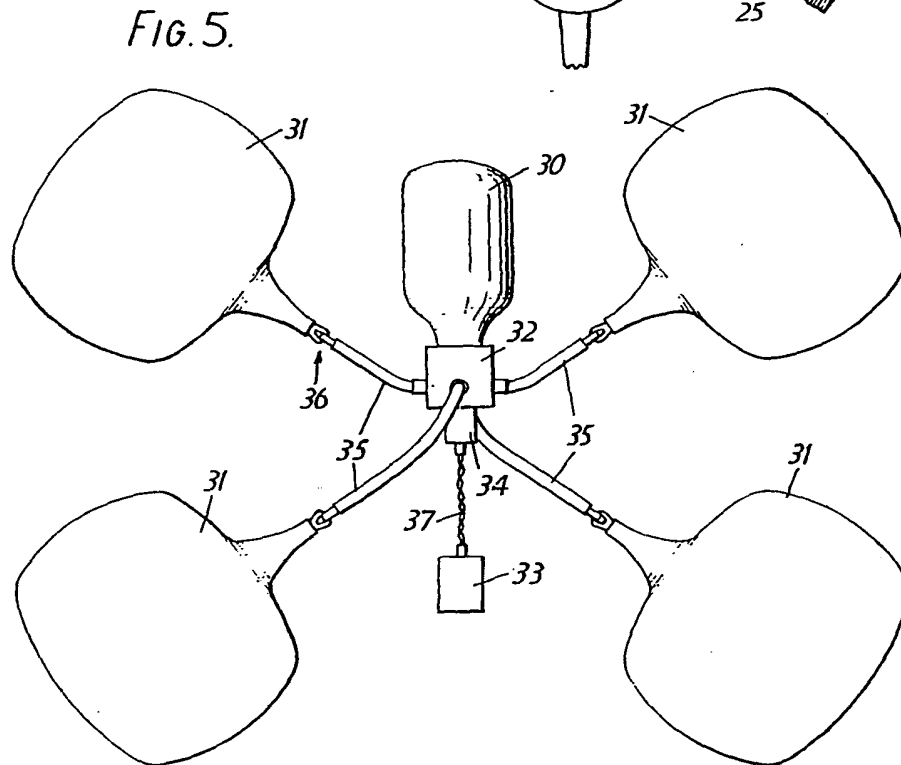
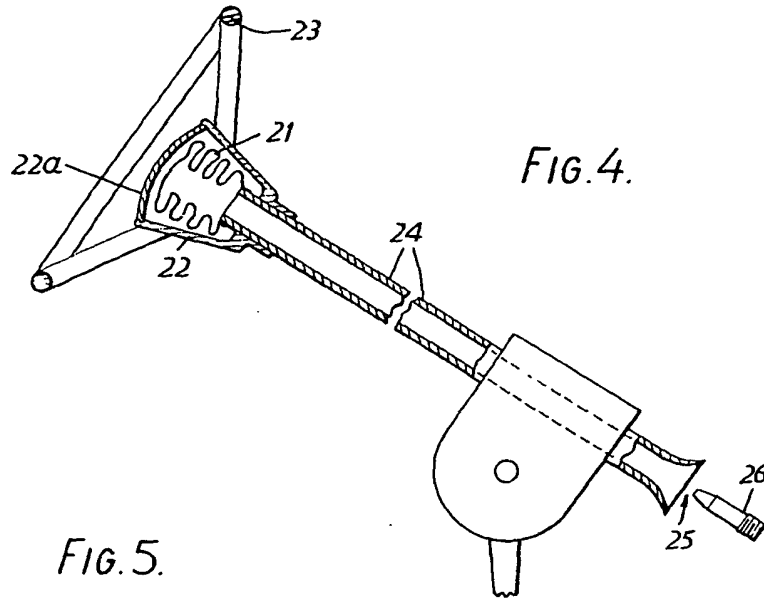


FIG. 6.

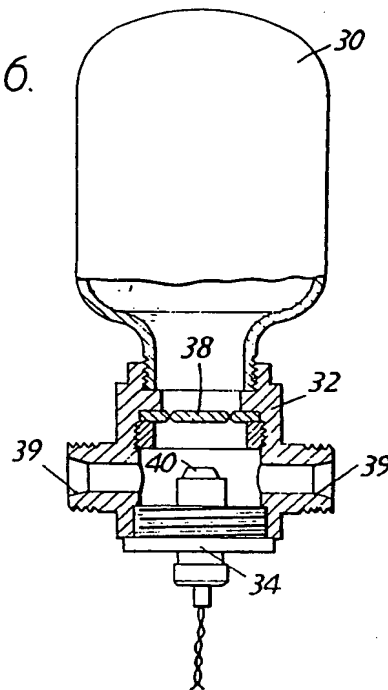


FIG. 7.

